Hydrogen-Bonding Surfaces for Ice Mitigation

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Abstract

Under a NASA Aeronautics Research Institute Seedling activity, surfaces with controlled chemical functionality and linear chain length were evaluated in a simulated icing environment to assess the effect of both parameters in mitigating ice formation. Linear alkyldimethylethoxysilanes terminated with hydrogen-bonding (HB) and non HB groups were prepared, characterized, and subsequently used to coat aluminum (Al) surfaces. These coated surfaces were tested in the Adverse Environment Rotor Test Stand (AERTS) at Pennsylvania State University from -8 to -16°C to determine the effect upon ice adhesion shear strength. The icing cloud density (i.e. liquid water content) was 1.9 g/m^3 with a water droplet mean volumetric diameter of 20 μm. Results for one component surface compositions indicated that terminal group chemical composition as well as linear chain length for both types of HB interactions affected ice adhesion shear strength. When two component surface compositions were evaluated, the results were found to depend on the type of functional group and linear chain length for each component present as compared to the pure surface. Based on these results, novel monomers were prepared and incorporated into epoxies that were subsequently used to coat Al surfaces to be tested in AERTS under similar conditions.